TREE IMPROVEMENT

Volume 5, Number 1 August 1992

Seed and Seedling Extension Topics

Robb Bennett – Editor

A new year, a new volume, and yet another new editor. Well, maybe the year is not so new anymore and, yes, this issue should have been in your hands months ago. Reorganization of parts of Silviculture Branch is somewhat to blame for the delay. We are back on track now and a second issue is scheduled for release before the end of the year. Your submissions for publication in the next issue are hereby solicited. Please don't be shy. The need for this publication is supported by the Client Satisfaction Survey Results. It is the perfect vehicle for unpublished research, technical tips, reviews, notices, meeting reports, new ideas, and the dissemination of other relevant information that might not be readily accessible to readers. Send in your manuscripts (hard copy or, preferably, on 3.5" disks) as soon as possible for consideration. To all those who submitted articles for this issue I thank you very much for your interest in and support of this publication. I apologize to those whose work I edited but did not have time to return for their approval. Special thanks are extended to Leslie McAuley for serving as interim editor prior to my appointment.

Restructuring and Staff Changes in Silviculture

Effective April 1, 1992 the Nursery and Seed Sections of the BC Forests Silviculture Branch were reorganized to more effectively deliver services. Nursery and Seed Extension Services and Nursery and Seed Operations have been replaced by Nursery Services and Seed Services. New organizational charts are included below.

Seed Services, under Jenji Konishi, handles

a) seed planning;
b) management of orchards, orchard pests, and the Seed Centre;
c) seed extension services; and
d) equipment development for both seed production and nurseries.

Recent staffing changes include Brian Barber (Seed Orchard Projects Officer - 746-1225), Berken Feddersen (Seed Planning Officer - 387-8951), Robb Bennett (Seed Orchard Pest Management Officer - 387-3931), and Dave Reid (Coastal Zone Seed Production Officer - 746-1225). Nils Sjoberg (Equipment Development Officer) will be retiring this summer. At the Seed Centre (574-0461) Rob Bowden-Green has been seconded (for about eight months effective I April 1992) to serve as chairman of the SPAR project (see below), Heather Rooke is serving as Acting Manager, and David Kolotelo is the new Cone and Seed Improvement Officer.

Nursery planning, extension services, operations, and nursery administration for three zones (Coast - Vancouver Island, Southern, and Northern Interior) now are dealt with by Nursery Services under Drew Brazier. Don Summers is the new Manager of Nursery Extension Services (582-6904) in this section (see notice below for more information about the new Coast Nursery Administration and Nursery Extension Services facility). Cindy Haddow (387-8946) has replaced Mike Pelchat as Nursery and Administrative Planning Officer and Allan McDonald has been seconded for about six months (starting in mid-July) to work with her as Nursery Planning Coordinator. Susan Zedel is the acting Manager of Saanich Test Nursery during Allan McDonald's absence. The vacant position of Northern Interior Nursery Administrator will soon be staffed.

BRITISH COLUMBIA
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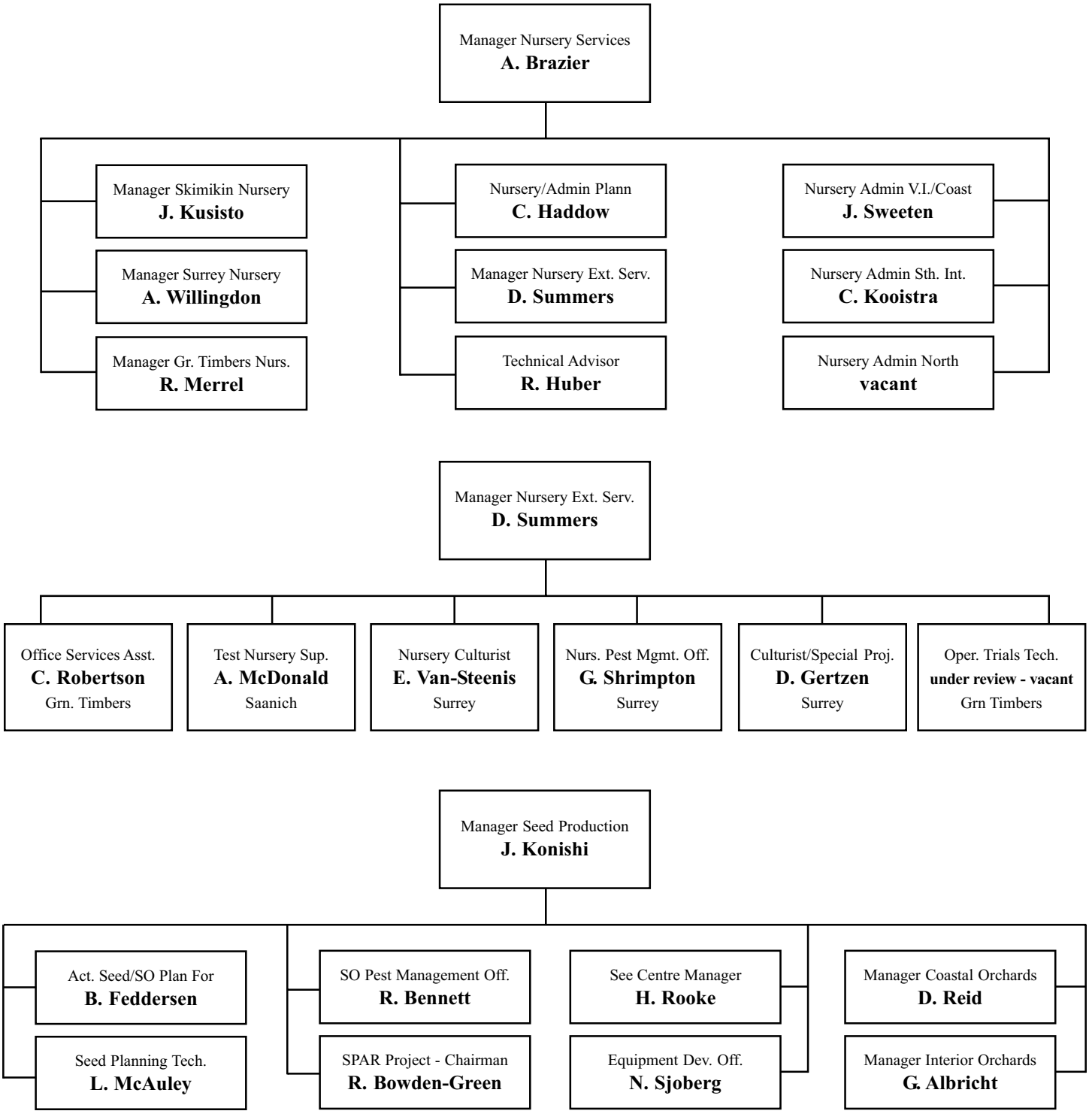
Manager Nursery Services
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Manager Skimikin Nursery
J. Kusisto
Manager Surrey Nursery
A. Willingdon
Manager Gr. Timbers Nurs.
R. Merrel
Nursery/Admin Plann
C. Haddow
Manager Nursery Ext. Serv.
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R. Huber
Nursery Admin V.I./Coast
J. Sweeten
Nursery Admin Sth. Int.
C. Kooistra
Nursery Admin North
vacant
Manager Nursery Ext. Serv.
D. Summers
Office Services Asst.
C. Robertson
Grn. Timbers
Test Nursery Sup.
A. McDonald
Saanich
Nursery Culturist
E. Van-Steenis
Surrey
Nurs. Pest Mgmt. Off.
G. Shrimpton
Surrey
Culturist/Special Proj.
D. Gertzen
Surrey
Oper. Trials Tech.
under review - vacant
Grn Timbers
Manager Seed Production
J. Konishi
Act. Seed/SO Plan For
B. Feddersen
Seed Planning Tech.
L. McAuley
SO Pest Management Off.
R. Bennett
SPAR Project - Chairman
R. Bowden-Green
See Centre Manager
H. Rooke
Equipment Dev. Off.
N. Sjoberg
Manager Coastal Orchards
D. Reid
Manager Interior Orchards
G. Albricht

New Facility Opens at Green Timbers

The Coast Nursery Administration Centre and the Nursery Extension Services sections of the BC Ministry of Forests, Silviculture Branch are pleased to announce their recent move to new facilities at the Green Timbers Reforestation Centre in Surrey, BC. The new address is:

14275-96th Ave.
Surrey BC
V3V 7Z2
fax (604) 775-1288

Individuals can be reached as follows:

Coast Nursery Administration Centre

Jim Sweeten,	Manager	582-6913
Shirley Sykes	Shipping Clerk	582-6917
Carol Kaiser	Technician	582-6904

Nursery Extension Services

Carol Robertson	Clerk-Receptionist	582-6904
Don Summers	Manager	582-6907
Gwen Shrimpton	Nursery Pest Management Officer	582-6914
Dave Trotter	Nursery Biologist	582-6910
Diane Gertzen	Culturist Special Projects	582-6918
Eric van Steenis	Nursery Specialist	582-6915

In addition to providing much needed office space for staff, the new facility has laboratories and greenhouses for conducting tests and trials to improve nursery practices and quality control. Many of these trials will be organized in cooperation with Saanich Test Nursery and other sites around the province. Several fields on site will be used for demonstration plantations. A comparison of emblings and seedlings has been established to demonstrate some of the work being done with BC Research on new propagation methods. Two plantations are also planned which will illustrate some activities relating to the Christmas tree industry.

The Coast Nursery Administration Centre and the Nursery Extension Services section look forward to serving the nursery industry from their new site and to new and continuing cooperative projects.

Don Summers
Nursery Extension Services, Surrey

Seed Planning and Registry System (SPAR)

SPAR is a new system being introduced by the Ministry of Forests, Silviculture Branch to replace the ten-year-old Tree Seed Register (TSR - registry and inventory of tree seed) and Sowing Request (SR - orders for tree seedlings) systems.

Major changes in the new system consist of:

- on-line access for planning and submitting requests (seedlings or cone and seed services),
- inclusion of unregistered seed and cutting lots.

Benefits to SPAR users are:

- on-line access at district, region and branch levels; reduction in manual workload:
  - ability to search for suitable seedlots,
  - seed transfer guidelines application automation;
- ability to designate a portion of any seedlot as “reserved” for the exclusive use of the owner;
- ability to enter requests for seedlings at any time during the year (and for future years), cuttings, and cone and seed services.

Under SPAR, inventory and ordering functions will be combined and expanded to an extent that was not possible with T’SR and SR. Also SPAR will have the potential to link with other silvicultural information systems.

Phase 1 (cone collection planning and seed inventory) has been in operational use since early July. Phase 11 (sowing requests) will be available in September.

Questions or comments on SPAR can be directed to one of the following:

Rob Bowden-Green	574-0461
Cindy Haddow	387-8949
Leslie McAuley	387-8937
Heather Rooke	574-0461

Client Satisfaction Survey Results

The responses of clients of the Seed and Nursery programmes of the Silviculture Branch to the "Satisfaction Survey" have been analyzed and a brief overview of key findings follows:

1. **Orchard Services**
   a) General Program Services. Staff help and advice is valuable particularly with respect to pest management issues. Orchard visits are frequent enough, well timed, useful, and professional.
   b) Seed and Seedling Topics Newsletter. The newsletter is valuable and moderately useful but too infrequent and needs some input from related areas of interest.
   c) Orchard Group Meetings. The meetings are useful and their current format is acceptable to most clients.
   d) Pesticide Applicators Course. Most respondents are happy with the current format but about a third of replies were negative. Objectives need to be clearly defined and course needs to be updated and refined as needed. Input from allied industries (e.g. agriculture) would be beneficial.
   e) Development Work Priorities. Emphasis needs to be increased on basic insect biology, insect monitoring, integrated pest management, and alternatives to chemicals.

2. **Nursery Services**
   a) General Program Services. Staff help and advice is valuable but more networking information is desired (i.e. what is being done elsewhere?). Pest management service is good but there is some desire for more extension material, site work, and trials. Nursery visits are useful and professional but could be more frequent and better timed.
   b) Seed and Seedling Topics Newsletter. The newsletter is valuable.
   c) Nursery Growers Meetings. Many clients are dissatisfied with the current format.
   d) Pesticide Applicators Course. Most are satisfied with the format.
   e) Development work priorities. More development work is needed in conditioning of stock for field use, seedling standards and harvesting methods, and biological controls.

3. **Seed Centre Services**
   a) Diversification of Services. Alternatives to the Tree Seed Centre would expedite client's business.
   b) Current Services. Seed Centre services are reliable and of high quality. Seed tests meet operational needs.
   c) Information Management. Program should provide better information on orchard seed availability. Seedlot information should not be confidential.

To receive **Seed and Seedling Extension Topics**, or to correct your mailing address; please complete the following form and mail a printout to:

☐ Address Change - Please include copy of old label
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Grower's Notes

Vacuum Up *Botrytis?*

It may sound silly, but it works. Anyone who grows larch knows needles begin to drop in the fall and accumulate in thick layers on top of the blocks. Often Botrytis starts growing in the fallen needles and spreads to healthy portions of the tree. Workers at North Woods Nursery, Inc. (Elk River, Idaho) and the University of Idaho Forest Research Nursery (Moscow, Idaho) have been removing this build-up with a shop vacuum. One person can do about 5500 seedlings per hour and generally one treatment is sufficient. The shop vac is strong enough to remove the needles and most of the grit or other top dressing. Both nurseries each grew and treated about 90,000 larch seedlings this past season. The procedure was so effective chemical control of *Botrytis* was not needed. The vacuum treatment also helps keep the greenhouse cleaner and greatly reduces the amount of dead needles and top dressing accumulating in the packing shed or packed with seedlings.

Kas Dumroese
Forest Research Nursery, Moscow, Idaho

Prairie Dog Solution

A Victoria Times Colonist article from the Associated Press (24 January 1992) reported a solution to prairie dog problems. Apparently a person in Colorado has come up with a system called **Dog-Gone** that can vacuum the critters out of their holes alive. Once captured, the "dogs" can be moved or destroyed, in accordance with local ordinance. This is not the first report of vacuums being used to manage pests. In California and elsewhere in the United States vacuums are used to keep populations of aphids under control in lettuce and some other field crops.

Dan Summers
Nursery Extension Services, Surrey

More on Rodent Management

Gary Giampa reports from Kalamalka Seed Orchard that a "herd" of about 90 marmots (protected under the Wildlife Act) was successfully eliminated there without bloodshed or other mayhem. A hired trapper put out apples in the orchard for a week to accustom the marmots to this food source and then set live traps out containing apples. The marmots were captured and removed to a "suitable site."

The inaugural issue of BC Pest Monitor (a newsletter about Integrated Pest Management issues edited by Linda Gilkeson and published by the Ministry of Environment, Lands, and Parks - see below) reviewed a new rodenticide recently-registered in Canada. Quintox® (active ingredient - Vitamin D) is a valuable alternative to other rodenticides because it is non-hazardous for humans (and accepted by some organic certification bodies), no protective equipment or procedures (other than washing hands after use) are required, and secondary poisonings in animals that eat affected rodents (dogs, cats, raptors, snakes, and other predators) are eliminated.

Robb Bennett
Seed Orchard Pest Management, Victoria

BC Pest Monitor - The Newsletter of Integrated Pest Management in British Columbia

The first issue of this new publication (May 1992) carried articles on basic IPM; IPM in BC, urban parks, and Vancouver Parks; IPM policy of the Vancouver Parks Board; and Coquitlam's integrated vegetation management plan as well as brief reviews of topical publications and new products. Publication is in May and November.

To subscribe (no charge) contact:

Pesticide Management Branch BC Environment
4th Floor, 737 Courtenay Street
Victoria, BC VSV IX4
Fax: (604) 387-8897

Volume 5, Number 1 August 1992

Tech Talk

BC Reforestation Nurseries - Pesticide Use Facts

As with most agricultural, crops the production of conifer seedlings for reforestation in BC sometimes requires the responsible use of pesticides. Pesticides are substances intended for controlling or managing pests and include all fungicides, insecticides, herbicides and others. Nursery industry policy is to use pesticides only after other non-chemical methods of control have been ineffective. The least amount of the appropriate chemical is then used to control the pest problem in compliance with all notification, registration, environmental and regulatory agency requirements. All personnel applying pesticides on nurseries have a pesticide applicators license or are supervised by a certified pesticide applicator.

In BC there has been a significant reduction in pesticide use at forest seedling nurseries over the last 3-5 years. Some nurseries in the province are producing stock entirely pesticide-free, and at most facilities there is at least one stock type that is produced free of pesticides each year. There are almost no herbicides applied to container seedlings, which currently represent over 90% of the stock produced. In 1991 approximately 25% of stock lifted at nurseries for the Ministry Program had not been treated with pesticides within one year of lifting. We expect the proportion of unsprayed stock to increase with the elimination of the mandatory pre-storage fungicide application when stock is not infested with disease (see Trotter *et al,* this issue).

There are several reasons for the reduction in pesticide use. Over the last 10 years Integrated Pest Management programs utilizing biological, cultural, physical, and regulatory control (in addition to chemical control) have been developed. Many insects are manually removed and destroyed. Biological control agents are continuously being tested. Improvements are being realized in nursery sanitation, crop nutrition, irrigation regimes, crop spacing, and growing media. Pest monitoring programs are being, and have been developed. Finally, stock destined for the 1+0 summer ship program is grown early in the year when many pest populations are inactive and, as a result, is usually pesticide free. Requests for this stock type are increasing each year.

When pesticides are necessary, residues on stock can be a concern to handlers. The majority of work with pesticide residues on conifer seedlings has been with fungicides, especially captan and benlate because they are recommended as pre-storage applications and are therefore the two compounds most likely contacted by industry workers.

Captan was registered in Canada in 1951 and is very widely used in agriculture and horticulture. This compound is not readily absorbed through the skin and has a low acute toxicity in animals (oral LD_{50} 8,400) when swallowed or inhaled in a single dose. Concerns over health effects arise from long-term exposure, inhaling dusts or mists, or ingesting residues on food. There is insufficient evidence to determine whether captan causes cancer, birth defects or genetic damage in humans.

Benomyl was registered in Canada in 1967 for use on fruits, nuts, vegetables, turf and field crops. It has a low acute toxicity when swallowed or breathed (oral LD_{50} 9,600.), is not easily absorbed through the skin or the gastrointestinal track, and does not accumulate in animal tissue. Benomyl that does enter the bloodstream is metabolized in about 24 hours and excreted in the urine. Concerns about the effects of benomyl on human health arise from reports of allergic dermatitis among workers and from studies indicating adverse effects on the male reproductive system and increased liver cancer in mice. In most people benomyl causes either mild or no skin irritation, but allergic dermatitis has been reported in women of Japanese origin.

The report "Exposure of Tree Seedling Nursery Employees to Captan, Benomyl and Chlorothalonil" was prepared for the Forest Industry Industrial Health Research Program by BC Research in 1986. The total dust concentrations in workplace air and breathing zones of sorters and lifters were measured. At the test nursery chlorothalonil (oral LD_{50} 10,000) had been applied monthly throughout the growing season and captan and benlate were applied 3 days before lift. Because these fungicides are not readily absorbed through the skin, dust that may be released from the foliage is of more concern. Most airborne concentrations from breathing zones were less than 0.002 mg/m^3. This is more than 1,000 times lower than the recommended Threshold Limit Values (TLV) for captan and benomyl as set by the American Conference of Governmental Industrial Hygienists.

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The report concluded that concentrations of captan, benomyl and chlorothalonil measured in the breathing zone of nursery employees were low enough that there is no reason to be concerned that their health will suffer from airborne dusts.

The report, "Exposure of Tree Planters to Fungicides", prepared for the Forest Industry Industrial Health Research Program by BC Research in 1988, showed that typical exposures on the hands, wrists and forearms of planters after planting 500 to 2000 trees per day were: 0.2 ug/day for captan and 11 ug/day for benomyl. Several studies of U. S. Strawberry Harvesters found dermal exposures ranging from 4,700 to 17,410 ug captan/hour. These dermal exposures are well below accepted maximum levels. However, the report recommended that tree planters should take simple routine precautions to minimize health risks. The report also concluded that concentrations of captan, benomyl, and chlorothalonil in the breathing zone of tree planters were low. None of the personal air samples exceeded 0.00016 mg/m^3. Measured concentrations were much lower than maximum levels permitted by the Workers' Compensation Board (WCB) of BC, or TLV's of the American Conference of Governmental Industrial Hygienists. The WCB has a permissible concentration of 5 mg/m^3 for captan. The TLV for captan is also 5 mg/m^3 and 10 mg/m^3 for benomyl. No WCB or TLV limits have been established for chlorothalonil.

The 1988 study also analyzed seedlings for fungicide residues at time of planting. Values ranged from an average of 1.1 to 15.0 ug/g for benomyl and 1.0 to 3.9 ug/g for captan. Surveys conducted by the Ministry of Forests Silviculture branch in 1991 and 1983 found that residues on crops sprayed according to label rates were below the limits of .5 - 10 ug/g for benomyl and 5 ug/g for captan as set by Health and Welfare Canada for edible crops. According to government guidelines residues on conifer seedlings are not a concern.

Gwen Shrimpton
Nursery Extension Services, Surrey

Gray Mould *(Botrytis cinerea)* on Stored Conifer Seedlings: Efficacy and Residue Levels of Pre-Storage Fungicide Sprays

Introduction

In British Columbia, the practice of storing conifer seedlings over the winter months has proved to be a valuable logistical planning tool in current silvicultural operations. By keeping stock dormant in cold storage until reforestation sites are ready for spring planting, seedling survival is greatly enhanced. Also, seedling storage has helped nursery facilities to be more efficient in the lifting, grading, and shipping of large numbers of seedlings. An unfortunate consequence of this process has been the outbreak of mould infestations in stored conifer seedlings. One of the most common storage moulds encountered is gray mould, *Botrytis cinerea. All* conifer species grown in B.C. reforestation nurseries are susceptible to moulding in cold storage.

Historically, severe infestations have been the result of poor cultural practices, variable storage and handling techniques, and a lack of information on the epidemiology of the moulds. Storage coolers were traditionally kept at 2 to 4°C because the effect of long term sub-freezing storage on conifer seedlings was not known. To ensure seedling quality, standard B.C. Ministry of Forests policy has been to apply fungicide sprays to all seedlings prior to storage to reduce or eradicate the mould inoculum.

In recent years, improved cultural regimes and integrated pest management techniques have resulted in a dramatic increase in seedling quality. In addition, various studies have shown that almost all conifer species currently grown in B.C. reforestation nurseries can tolerate sub-freezing temperatures for extended periods. Most storage moulds grow extremely poorly or not at all at these temperatures. Seedlings destined for spring planting on reforestation sites are now lifted in late fall or early winter, graded, bundled and then stored in enclosed boxes at -2 to -4°C for 2 to 6 months. With these improvements in seedling quality, handling, and freezer storage the need for mandatory fungicide sprays has become questionable. In addition, nursery personnel and tree planters are concerned about over- exposure to fungicide residues on the seedling foliage.

This study was done to determine: i) if predisposition to storage mould can be predicted, ii) if the pre-storage fungicide sprays are effective, and iii) the fungicide residue levels on seedling foliage prior to storage and at shipment. Contact the senior author for details of methodology and results.

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Conclusions

The results of this trial indicate predictions for mould potential of a crop can be effectively made but a sample assay should be included to backup the assessment. Pre-storage fungicide sprays are unnecessary for seedling crops deemed "clean." Sprays are effective (under operational conditions and at the recommended rates) on "pre-disposed" crops (any crop that is stressed, extremely succulent, over-height, has a high proportion of senescent tissue, or any combination of these factors). No amount of spraying will preclude the onset of a heavy mould infestation in "predisposed" crops. Care must be taken through the entire life of the crop to ensure an optimal growing regime. Efforts made to ensure that a well-balanced seedling goes into freezer storage will increase its chances of avoiding severe mould infestation after thawing. This is important because pre-storage sprays act primarily as a "clean-up" with little or no residual effects.

Concerns over fungicide residues on conifer seedlings appear to be unfounded. In general, for crops sprayed under operational conditions, residue levels for both fungicides used in this study (Captan 50 WP – oral LD_{50} 8,400 and Benlate 50 WP – oral LD_{50} 9,600) were well within the limits set by Health and Welfare Canada (5 ppm) and sampling surveys done by B.C. Ministry of Agriculture and Fisheries for edible berry crops. An extensive survey of residue levels of captan, chlorothalonil and benomyl on conifer seedlings (in B.C. reforestation nurseries) at, during, and after storage showed similar findings (Maxwell, 1982). The hazard to nursery personnel and tree planters exposed to fungicide residues is extremely low in comparison to other agricultural activities (FIIHRP, 1986). Crops sprayed with backpack sprayers in this study were prone to overspraying resulting in high residue levels. The long-term consequences of overspraying (e.g. reduced efficacy, build-up of resistance) are well-documented (Glover *et al,* 1987, Glover, 1985). Care always must be taken to ensure conifer seedlings are sprayed only when necessary (and under controlled conditions) and with the recommended fungicides at the correct rates.

Recommendations

Based on the results of this study, the following recommendations are made:

1. The nursery and its client should assess the crop for mould infestation potential prior to lift.
2. A representative sample should be assayed for mould potential under optimal conditions (either on site or at the Pacific Forestry Centre Nursery Disease Clinic).
3. Only seedlots identified as "pre-disposed" should be sprayed (with the recommended fungicides at rates indicated in the Nursery Production Guide (BCMAF, 1990).
4. To increase worker safety, fungicide sprays should be applied 2-3 weeks prior to lift and the crop should be irrigated a few days prior to lift to wash off any remaining foliar residues.

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D. Trotter, G. Shrimpton
Nursery Extension Services, Surrey
J. Dennis
Pacific Forestry Centre, Victoria
S. Ostafew, C. Kooistra
Nursery Extension Services, Vernon

Assessing Nursery Stock for Gray Mould *(Botrytis cinerea)*

Grey mould *(Botrytis cinerea)* is a serious disease of forest nursery seedlings. The fungus infects dying plant tissues early in the year and proliferates when canopy and environmental conditions become conducive to growth (M. Peterson, pers. comm.). Control begins with growing healthy, non-susceptible trees in an environment unfavourable to the fungus. Weather conditions and some cultural practices may predispose seedlings to *Botrytis* infection and fungicides are then necessary for control.

Presence of grey mould should be verified before applying fungicides. Observations in the greenhouse can identify active, visible growth but often do not indicate future disease potential. Seedlings may be infected but the environment may not favour fungus proliferation. Latent or non-visible infections can be detected by incubating seedlings in an appropriate environment (warm and moist). The procedure is simple and requires no complex or expensive equipment but one must be able to correctly identify *Botrytis*. With some practice and a stereomicroscope quality control technicians should be able to identify this fungus. Otherwise samples can be sent to the Pacific Forestry Centre Pest Clinic for identification or confirmation. Any unusual or unknown sample should be sent to the Clinic.

The incubation procedure is as follows:

1. examine the seedlings and record level of *Botrytis* fruiting bodies present (this provides an early indication of infection but the fungus may not be viable);
2. remove shoots from seedlings and wash shoots with tap water to remove "old" fruiting bodies;
3. place shoots onto wet paper towels in a plastic bag, inflate the bag with air, and seal;
4. keep bag at room temperature and normal day light;
5. examine material with microscope after 48 hours and again at ten days for "fresh" fruiting bodies.

If new fruiting bodies are present, the fungus is viable and has a food base. This does not necessarily indicate a serious problem. Morphological and physiological condition of the plants determine if the stock is predisposed to disease (see Trotter *et al.,* this issue).

Sampling procedure is important. A random sample of ten to 20 plants is adequate for uniform crops but additional samples are called for if the growing environment is variable or there are suspected grey mould "hot spots." Samples should be representative of the entire crop. Proper seedling handling, storage, and thawing are also very important - healthy seedlings may become infected if damaged during extraction, if low storage temperatures are not maintained, or if thawing of the stock is prolonged.

Contact Dave Trotter (Nursery Extension Services, Green Timbers Nursery, Surrey) or John Dennis (Pacific Forestry Centre, Victoria) for more information.

John Dennis
Pacific Forestry Centre, Victoria

Pythium Water Mould in British Columbia Forest Nurseries

Seedling root rots have increased in importance in British Columbia nurseries over the past few years. Two of the most important root rot fungi are *Pythium* and *Phytophthora.* Although bareroot nurseries have suffered some losses from *Phytophthora, Pythium* is the main water-borne pathogen of both container and bareroot seedlings. *Pythium*-caused diseases occur on seedlings of all the major tree species. Spruces are most susceptible with Douglas-fir a close second. *Pythium* is a "nibbler" that attacks root hairs and short roots of juvenile plants. Under ideal conditions, Pythium can affect the main taproot and primary laterals of first and second year seedlings.

The most important prerequisite for *Pythium* disease is high soil moisture. Roots do not have to be continuously waterlogged to be attacked - intermittent periods of saturation encourage *Pythium*. Nursery cultural practices often create ideal conditions for *Pythium*. Cool, overcast weather combined with media compaction and reduced drainage result in cavities that drain slowly. Bareroot trees also experience these conditions in clay soils or in soils with seasonally high water tables.

The main question growers ask is "From where does *Pythium* come?" It is found on used styroblocks, wooden pallets, field soils, and irrigation water. To date, it has not been isolated from seeds, peat, or vermiculite. By determining the source of the fungus, nursery personnel can use cultural techniques to manage this disease.

Pythium is not the most common pathogen of container-grown seedlings, but it is found routinely on uncleaned styroblocks. Blocks from infected crops are most likely to carry over the fungus but

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asymptomatic crops may have the fungus in the growing medium and thus on the styroblocks. *Pythium* can remain viable on styroblocks exposed to severe winter conditions. Effective cleaning methods have greatly reduced the amount of *Pythium* found on this source.

Windblown soil particles can contain *Pythium*. Because this fungus is a pathogen of field crops, fields adjacent to nurseries can be a source of windblown inoculum. Soil samples from fields or fallow areas can be used to determine if such fields are contaminated. Nearby fields should be cultivated during calm weather to reduce such inoculation.

Irrigation water is also a major source of *Pythium.* Several samples of creek, pond, and reservoir water assayed by the Pacific Forest Centre contained *Pythium*. Using an infected water source introduces inoculum into the greenhouse and unless thorough sanitation is accomplished disease potential can increase annually. Chlorinated water is free of this fungus.

A technique developed at Oregon State University and Peninsulab (Washington) can be used to determine if a water supply is infected. The procedure uses pears as bait to attract swimming spores. Prior to the use of baiting tests, 1 to 4 litre water samples were assayed for *Pythium* but, because of the small sample size, the fungus was rarely found. Large quantities of water are used to irrigate crops and low numbers of *Pythium* propagules can cause significant losses in the nursery. Placing unripe pears 2 to 8 cm below the water surface near a pond or reservoir outlet effectively increases the volume of water sampled. Pears should be wrapped in porous cloth (e.g., "J" cloth, cheesecloth) or nylon screens (if rodents or birds are a problem). Keep the pears in the water for four (@ 15-20°C), five (@ 10-15°C), or seven (@ 5-10°C) days. If *Pythium* or *Phytophthora* is present firm, brown lesions will usually be formed on the fruit. If no lesions develop the pears can be kept in the water longer or incubated in the lab. Bacteria or non-Pythiaceous fungi may cause similar lesions but do not always indicate a potential disease problem. For positive identification pieces of decayed pear tissue are placed on *Pythium/Phytophthora* selective culture medium. If the water supply contains *Pythium* either do not use it or treat it before use with 2 ppm chlorine.

Management of water-borne diseases requires an integrated approach. Steps should be taken to reduce the inoculum applied to the crop.

Several procedures are appropriate.

1. Use pathogen-free water, peat, containers, benches, and equipment. Do not introduce pathogens via diseased plants or infected equipment from other nurseries.
2. Thoroughly clean all equipment and greenhouses between crops and do not have cull piles situated near production areas.
3. Choose sites protected from wind-blown soil.
4. Avoid soil sterilization. Natural microflora can help reduce levels of *Pythium* (it is a poor soil competitor). Inoculations with biocontrol agents or mycorrhizal fungi have shown promise.

The following cultural practices favour seedlings but not *Pythium*.

1. Use a well-aerated, well-drained soil mix. Where possible incorporate amendments that have been shown to discourage *Pythium* root diseases (e.g., wood chips, bark).
2. Do not allow the growing medium to be wet for extended periods.
3. Avoid abiotic stress to seedlings.

These practices reduce inoculum potential, lower the infection count, and enhance disease resistance in seedlings.

Once *Pythium* root rot has been identified, major damage has already occurred on the roots. Because the fungus moves slowly in the roots, shoot symptoms are not obvious until a critical level of decay significantly inhibits water or nutrient uptake. Control is then remedial. Affected seedlings may survive but not meet grading standards. Shoot symptoms include chlorosis, stunting, wilting, and tip necrosis. In addition to moisture control and sanitation procedures, affected trees should be separated from healthy stock or rogued to prevent inoculum build-up and spread. No fungicides are registered for use against *Pythium* in forest nurseries but metalaxyl (oral LD_{50} 870) has been effective for its control in US forest nurseries. Fungicide combinations such as metalaxyl and mancozeb (oral LD_{50} 7,500) are now being considered to prevent buildup of resistance.

For current chemical control measures contact Ministry of Forests Nursery Extension Services. The Pacific Forestry Centre's Pest Clinic will assay for *Pythium* in or on soils, water supplies, equipment, containers, and diseased plants on request. Samples should be representative of the problem, packaged so they will not dry out, and sent as quickly as possible to PFC.

Water moulds do not need to be a serious problem in forest nurseries. They are weak, opportunistic fungi requiring rather specific conditions to flourish. Through proper silvicultural practice, sanitation, and careful monitoring losses can be kept to a minimum.

Jack Sutherland, John Dennis
Pacific Forestry Centre, Victoria

Keithia Leaf Slight on Western Red Cedar Nursery Seedlings

Keithia blight of Western red cedar (WRC - *Thuja plicata)* is caused by the native North American fungus *Didymascella thujina.* The pathogen is found throughout the range of WRC and Northern white cedar. In British Columbia the disease has recently become especially severe on container-grown and transplant (1p+1) WRC (in 1991 over 1 million infected seedlings were discarded in coastal nurseries). All age classes of WRC are affected. Seedlings and young regeneration are most affected although the disease does not express itself obviously in first year seedlings and is rarely observed at this stage. Older trees may be stunted and occasionally entire branches are killed. Death of the host tissues may be the result of toxin production by the fungus. Presence of several lesions on a stem may also be important in causing branch or stem death, particularly when lesions girdle the stem.

On first year WRC seedlings Keithia blight damage is generally confined to individual leaves on the lower stem. On mature foliage the first symptoms appear as several small, cream-coloured areas mostly on the upper surface of leaves. Small lesions seen on these areas slowly turn brown. At this stage the first spore-producing bodies (apothecia) usually appear. Apothecia become more conspicuous on first year foliage by late June when they look like swollen, red-brown to olive brown spots against the duller brown background of dead tissue. Up to three apothecia (but usually only one) may form per leaf. Under moist conditions when mature the apothecia become black-ish and swell until the overlying leaf epidermis splits and exposes them. Transmission to uninfected leaves is through spores only and not by vegetative growth from leaf to leaf.

Keithia blight can be confused with normal foliage colour changes, which occur, on cedar in the autumn. However, this seasonal colour change affects the entire plant and contrasts markedly with the scattered, browned leaves typical of the early symptoms of Keithia blight.

In the field, symptoms usually become noticeable in April and May and are quite evident by June. Disease severity intensifies through the summer and fall, depending upon environmental factors. Apothecia begin to form in June. Spore discharge peaks in late summer and early fall and continues through October. Most spores appear to germinate in the same year and are the main source of primary infection. Some inoculum may come from leaves infected in the previous year. Spores are thick-walled and have a thick, gelatinous covering, which prevents desiccation and allows spores to remain viable for long periods.

Lab and field studies show that humidity is more critical than temperature in affecting spore discharge. In the field RH needs to be above 80% for spore discharge. Temperature apparently influences disease symptom development with spread being most rapid at 20°C. The fungus is dormant below 5°C. There is no evidence that any stage of the fungus can exist other than as a latent infection within leaves or as spores on leaf surfaces. Overwintering occurs on nursery stock, cedar hedges or cedars adjacent to the nursery.

Management for Keithia blight should be carried out throughout the growing season. Low seedling densities, non succulent foliage, high light intensity, and low RH all are likely to discourage infection and disease spread. To be effective, fungicides must thoroughly cover all foliage. Samples for identification should be sent to John Dennis (Pacific Forestry Centre, Victoria). Gwen Shrimpton (Nursery Extension Services, Surrey) should be contacted regarding control measures.

Harry Kope, John Dennis
Pacific Forestry Centre, Victoria

A Method for Quantifying Keithia Blight on Foliage of Western Red Cedar

Quantification of disease is important for establishing infection limits, monitoring disease, and for producing reproducible research results. For Keithia blight quantification traditionally has been based upon a visual, subjective estimation of percentage of leaf tissue infected – different observers can assign different percentages to the same level of damage. Furthermore, zero tolerance of Keithia blight is the rule at present but because the blight is endemic low levels probably will have to be tolerated in the future. How will guidelines for levels and limits of tolerance be established? A quantitative method (presented below) is needed to standardize results and enable guidelines to be set. The following method quantifies Keithia blight on foliage of entire cedar seedlings and has evolved from personal evaluations of both heavily and lightly infected 2-0, 1p+1, and 1-0 stock.

(continued...)

Lay out a cedar seedling flat upon a tabletop (this is easily done due to the relatively planar habit of the seedlings). From the top of the shoot choose the first three branches with ten or more branchlets (counting out from the main stem). Size of the branchlets is not important. Assess ten branchlets on each of the three branches. Consider a branchlet to be infected if it has at least three Keithia infected leaflets on it. Follow the same procedure for three branches at the base of the plant. Then determine the percentage infection with the following formula: $(x+y)+60x100=$ % where x is the number of infected branchlets (out of thirty) at the shoot top, y is the number at the bottom, and 60 is the total number of branchlets examined.

Three infected leaflets are chosen as the base rate because this is an easy number to identify on a branchlet when scanning a large number of branches (the contrast in colour between the brown diseased leaves and the green healthy foliage is simple to spot). Some branchlets have only a few leaflets while others may have hundreds. For the larger branchlets, I have found that counting a branchlet as diseased on the basis of only three infected leaflets does not bias the results towards an artificially high percentage of infection for that plant. These low scoring branches (5% infected foliage) accurately reflect the total percentage infection for the plant.

If there are insufficient branches (to assess a total of six) or not enough with at least ten branchlets then simply adjust the methodology to work with what you have. Misidentification of Keithia blighted leaves is a problem especially with wet foliage when debris may stick to leaves and obscure leaflets or otherwise cause inaccurate counts. Clean debris from the material before assessing.

Some 1p+1 material has been incubated in growth chambers this year and monitored for the progression of Keithia blight. When first assessed the infection level ranged from 40 - 75%. Five months later under the incubation conditions the disease had been arrested and the plants had grown. A second assessment reflected this new health. Top branches previously with fewer than ten branchlets had more than ten and these were Keithia free. On lower branches new Keithia free branchlets had grown from the area close to the main stem and were counted in the new assessment. These changes in the upper and lower sections of the trees effectively decreased the calculated percentage infection, which was evident already from general appearance alone.

As with any grading system this one will evolve under conditions of use. I would appreciate notification of any improvements so that this method can be updated.

Harry Kope
Pacific Forestry Centre, Victoria

White Pine Blister Rust *(Cronartium ribicola)* in British Columbia

Introduction

White pine blister rust (WPBR), a branch and stem canker disease of all five-needle pines caused by the fungus *Cronartium ribicola,* was introduced from Asia and had spread to the Interior of BC by 1930. In North America western and eastern white pine, sugar pine**,** whitebark pine, and limber pine are affected. As with all rusts WPBR requires an alternate host (in this case *Ribes* spp. - currants and gooseberries) to complete its life cycle. *Basidiospores* from *Ribes* infect white pine needles in the fall and cause the formation of cankers on branches. *Pycniospores* are formed in a couple of years and are spread by flies to other cankers where cross-fertilization takes place. This results in the formation of *aeciospores,* which infect *Ribes* the following spring. *Urediospores* intensify the infection within *Ribes* through the summer. In the fall *telia* are formed on *Ribes* and start producing new basidiospores. The fungus grows on living tissue. Expanding cankers eventually girdle the branch or stem and cause all parts of the tree above the canker to die.

Options

Experiments with fungicides (such as extremely toxic Actidione - oral LD_{50} 1.8) and a large scale Ribes eradication program have done little to slow down the progress of the disease. Other efforts to control the disease include the identification of high-hazard sites, concentration of white pine plantings elsewhere, and using apparently resistant trees as a seed source. There is resistance in natural populations and natural selection can be expected to eventually take care of the problem but this will probably take too long.

A full-scale breeding program would greatly help the situation. This would include the selection of parent trees, progeny screening, controlled crossing of the best individuals, and screening of their offspring, etc. Trees representing different proven resistance mechanisms would then be grafted into seed orchards. The success of such a program will restore white pine as a commercial species in BC.

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Progress

White pine management and blister rust control workshops in Nanaimo and Revelstoke in 1979 recommended that:

a. white pine rehabilitation should receive high priority;
b. a review of gene pool preservation, site hazard rating, wood properties, and demand should be undertaken; and
c. information about selection, screening, test plantations, and seed orchards should be obtained for a resistance and tolerance breeding program.

In 1980, 750 seedlings from selected Arrow Lakes parents and 1,600 seedling from the second generation breeding program in Idaho were established in two plantations at Skimikin. The next year Dick Bingham (originator of the Idaho WPBR breeding program) addressed the SISCO workshop in Vernon.

SISCO produced a position paper on WPBR in 1982 recommending that a program be started to restore white pine to its status as a manageable component of the commercial forest. The following year the BC Forest Service signed a Memorandum of Understanding with the CFS (now Forestry Canada) to establish a tree improvement program to deliver rust resistant white pine material to seed orchards. Subsequently (1984) the CFS appointed Mike Meagher as white pine geneticist to start the improvement program in BC with Rich Hunt as pathologist. Stand surveys and parent tree selections were started in the West Kootenay, Mica, and Shuswap Adams zones. Interior trees selected to date number 227 and screening of their progeny is in progress. Other research projects initiated then include studies of rust races and sources, inoculation methods, resistant plantations, root disease plantations, molecular biology, and tissue culture.

In 1987 the Idaho plantation at Skimikin went into seed production management. In the following two years supplemental mass pollination was carried out at this plantation using Arrow Lakes and Idaho pollen. The 1989 harvest had a high level of cone abortion (perhaps due to extraordinary weather conditions and/or inadequate pollination). The 1990 harvest was much better: 7.2 hl of cones was harvested in the Idaho plantation and an additional 8.8 hl from the Arrow Lakes plantation.

In 1990, 3,000 white pine rootstock were potted at Skimikin. Scion material was collected from selected clones in the Idaho breeding program and in 1991 was grafted to the rootstock. The grafts will be planted in an orchard to provide an interim supply of seed containing a balanced mix of different resistance mechanisms. The performance of white pine when moved over a wide geoclimatic range leads to the belief that Idaho trees can produce seed for BC plantations. In the meantime the BC program is continuing and will deliver tested material for the establishment of seed orchards in BC.

Maarten Albricht
Interior Seed Orchards, Vernon

Ladybird Beetles at CPFP Nootka Seed Orchard

Cathy Cook, Barb Newberry, and Debbie MacLeod released predaceous ladybird beetles (Coleoptera, Coccinellidae) of the species *Hippodamia convergens* (obtained from Westgro Sales) this year in trials against Green Spruce Aphid (GSA - *Elatobium abietinum),* Balsam Woolly Aphid (BWA - *Adelges piceae),* and Balsam Twig Aphid (BTA - *Mindarus abietinus).* Trials will be monitored by Ministry of Forests Seed Orchard Pest Management over the summer and into next year for establishment of the beetle and efficacy of its control over the target insects. These trials have received considerable positive coverage in the local press.

GSA Trial

A total of approximately 175,000 beetles were released over three dates (March 24, April 10, April 28) this spring. Roughly 1,500 to 2,000 beetles were placed in a small area cleared of duff at the base of each of a number of randomly selected spruce trees and sprayed with a 1:1 flat Coca Cola/water solution to discourage flight and stimulate egg production (recommendation of Jim Matteoni, Westgro Sales). Eggs, pupae, and empty pupal skins of ladybird beetles have 5ubsequently been observed. Identification of new adults to confirm the establishment of the released species is pending. If *Hippodamia convergens* successfully Establishes itself in the spruce orchard at Nootka the next step will be to see if it can exert some level of control over the GSA during the late winter when the latter is most active.

BWA/BTA Trial

Four wood-framed, shade cloth covered cages were constructed by CPFP staff and placed over small Balsam fir trees *(Abies amabilis)* on 6 May. About 200 to 500 ladybird beetles were placed in three of the cages in the same manner as in the GSA

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trial. The fourth cage was treated as a control with no predators being released. Two of the test trees have populations of BWA only; the third has both BTA and BWA. Five branches per tree were flagged and the number of aphid nymphs was recorded prior to ladybird release. Further monitoring of this trial is scheduled for mid-summer.

Michelle Schmidt, Robb Bennett
Seed Orchard Pest Management, Victoria

Western Budworm in Kamloops and Okanagan Area

The western budworm, *Choristoneura occidentalis,* is a serious defoliator of Douglas-fir and can also damage a number of other BC conifers (especially spruce, *Abies,* and larch among others - this year it caused some damage to heavy hemlock cone crops at two Saanich peninsula seed orchards). Populations have been on the rise in the Kamloops/Okanagan area over the last couple of years and required aerial treatment with *Bacillus thuringiensis (Bt)* this spring. A moderate infestation (mostly in spruce but also pine) at the Skimikin seed orchard and nursery was successfully knocked back using ground spray applications of Bt in conjunction with the general Kamloops region aerial spray programme.

This insect overwinters as tiny, young larvae, which emerge early in the spring to feed on expanding buds. They enter new buds as soon as the bud caps are thin enough for the larvae to readily penetrate. Feeding can completely destroy buds prior to flushing. Feeding on surviving buds causes distortion, defoliation, loss of vigor, and even death of the developing shoots. Thiscan be extremely devastating, especially if terminal shoots of young seedlings are affected.

Feeding is finished and the caterpillars have pupated by late spring (early June this year in the Kamloops/Okanagan area). New adults emerge about ten days after pupation and fly, laying their eggs on the needles of host trees. Eggs hatch in about ten days and the new generation of caterpillars construct overwintering shelters (hibernacula) in sheltered places on twigs, under bark, or in lichens or moss where they wait out the winter.

Young larvae can disperse quite easily. They readily drop from buds on silk threads and can be carried for some distance by the wind using the threads as tiny Parachutes in much the same way that many spiders 'balloon." Infested stands around a nursery or seed orchard can act as sources of infestation (and re-infestation) during the early spring.

Control efforts in seed orchards are geared to protecting the cone buds and cones and/or protecting the foliage. Early treatments can save buds and cones but must be timed to coincide with bud elongation and larval emergence. This is difficult but can be done with close monitoring and some experience. After early treatment larvae may continue to disperse into the treated area from surrounding trees so continued monitoring (with possible future treatments) is essential. Later treatments are applied to protect the foliage from the voracious older larvae and need to be closely timed to the developmental stage of the larvae. Larvae are most destructive (but also most exposed) about the time that the new growth begins to harden up and needles start to flex.

In nurseries the situation is a bit different: the amount of foliage is limited and the larvae are often found on the terminal buds of seedlings. As very young larvae, western budworms are cryptic and hard to detect and control. Fortunately, once past the bud stage, twigs often are able to outgrow the feeding activities of the larvae. By the time the caterpillars become most voracious they are easily visible and can be contacted with insecticides. Handpicking can be practical for limited infestations or if populations are noticed during the thinning stages. However, 2-0 stock outdoors is probably most at risk, especially if it was moved during July of the first year during the flight period of the adult budworms.

A number of insecticides are registered for control of western budworm. Acephate (oral LD_{50} 866), Sevin (oral LD_{50} 400) and Bt are most commonly recommended. Each has its merits, depending upon circumstances. Discussions with the appropriate nursery or seed orchard pest specialist will help you decide which is best for your situation. For more information on your area or about western budworm contact Forestry Canada (Forest and Insect Disease Survey), your Forest Service Regional Entomologist, or the Forest Service Seed Orchard or Nursery Pest Management Officer.

Don Summers
Nursery Extension Services, Surrey

A New Woolly Aphid in the Okanagan

Adelges lariciatus, a woolly aphid new to the area, has turned up in western larch *(Larix occidentalis)* at the Kalamalka Seed Orchard. The larches are just beginning to produce a cone crop and the aphids are showing up in considerable numbers under the scales of many of the cones. As with many other species of adelgid aphids, this one has a two host life cycle with spruce *(Picea)* being the primary host (upon which galls are formed). The proximity of the larch orchards to the spruces at Kalamalka makes for an ideal situation for a population build-up of *A. lariciatus.*

A full life cycle takes two years and six generations to complete with one year on larch and one on spruce. There is variability and overlap of generations such that in natural populations all stages can be found at any one time. For those that might be interested the basic life cycle of *A. lariciatus* follows (condensed from "The life history and morphology of *Adelges lariciatus*" by M. E. P. Cumming in Canadian Entomologist, 1968, vol. 100(2), p 113-126):

1. *Fundatrices* (stem mothers) are wingless parthenogenetic females. They overwinter as nymphs on spruce, feeding in spring on the underside of twigs immediately below new buds. Their progeny are *gallicolae migrantes.*
2. *Gallicolae migrantes* develop in galls over the summer on spruce twigs. The galls are variable in form but usually sort of pineapple-like and not totally surrounding twigs or extending to tips (i.e. twigs can grow beyond galls). Adults are winged parthenogenetic females which fly to larch in late summer, settle on needles, and begin feeding and secreting a small amount of wax.
3. *Sistentes* are the progeny of the *g.m.*'s. They overwinter on larch as 1st instar nymphs usually on older bud scales. Sistentes develop into wingless parthenogenetic females the following spring and produce *progredientes* and *sexuparae.*
4. *Progredientes* remain on larch through the summer feeding on new cones if present or on leaf buds. Adults are wingless parthenogenetic females. Their progeny *(neosistentes)* remain feeding on cones. The fate of the *neosistentes* is uncertain.
5. *Sexuparae* also remain on larch but mature into winged parthenogenetic females while feeding on cones or buds. They fly to spruce in late summer and begin to produce *sexuales.*
6. *Sexuales* mature in the autumn into small wingless males and females (got to get some sex in there somewhere) which mate and produce the overwintering *fundatrices.*

Cones are being sampled at regular intervals to monitor the aphids and watch for signs of damage. Any seed damage will be assessed at cone harvest. At the time of this writing (mid-July), within the larch cones sistentes and their young offspring are present in variable numbers and are found mostly at the edges of the seeds. In severely infested cones the populations spill out onto the surface of the cones at the scale margins. No winged forms (sexuparae) have been noticed developing in the cones yet.

Thanks are extended to Bob Duncan at the Pacific Forestry Centre for identifying this insect.

Robb Bennett
Seed Orchard Pest Management, Victoria

Saanich Test Nursery Trial Reports

Previous Trials

Final reports on the following operational trials are now available:

1. **SX90201Q - A Comparison of the Effect of Four Levels of Potassium Silicate Application on Conifer Seedlings**

Abstract - Seedlings fed four different levels of potassium silicate displayed elevated tissue silicon levels corresponding to nutrient levels, but didn't appear to benefit with regard to overall vigour or health, or resistance to disease.

2. **SX90202Q - A Comparison of the Effects of Five Different Ammonium/Nitrate-based Fertilizers an Conifer Seedling Growth**

Abstract - The ratio of ammonium to nitrate nitrogen in fertilizers exerted an effect on top growth of Douglas-fir, lodgepole pine, and interior spruce. Overall, root growth, as measured by root dry weight, was not affected. It is suggested that NH_4/NO_3 ratios might be used to control exponential growth.

(continued...)

3. **SX90203Q - A Comparison of Five Peat Moss Soil Mixes and Four Non-Peat Moss Mixes, and Their Effects on Conifer Seedling Growth**

Abstract - The three commonly used peat mosses, Parkland, Premier, and Lakeland produced some small variation in conifer seedling top growth but little difference in root growth in white spruce, Douglas-fir, lodgepole pine and western red cedar. Generally, peat moss/mineral wool mixes performed well as did 100% basaltic wool. Slag-based mineral wool without peat moss didn't produce acceptable results. Cellulose acetate produced a good crop if the cultural regime was modified for its special requirements.

4. **SX90204Q - Comparison of the Effect of Nijssen Light Emitting Diodes to High Pressure Sodium Vapour Lights on Conifer Seedling Growth**

Abstract - Growth of interior Douglas fir and white spruce seedlings grown under Nijssen light emitting diodes compared favourably to those grown under high pressure sodium vapour lights.

The following reports will soon be available:

1. **SX91201 - A Comparison of the Effect of Elevated Levels of Potassium Silicate Application on Conifer Seedlings**
2. **SX91202Q - Comparison of the Effect of Nijssen Light Emitting Diodes to High Pressure Sodium Vapour Lights on Secondary Needle Development in Lodgepole Pine**
3. **SX91203Q - A Comparison of Three Peat Moss Soil Mixes and a Non-Peat Moss Mixes, and Their Effects on Conifer Seedling Growth**

Current Trials

The following trials are under way this year at Saanich Test Nursery:

1. **SX92201Q - A Comparison of the Effects of Amino Acid Supplements, Microorganism Amendment, and Six Proprietary Fertilizers on the Growth and Development of Conifer Seedlings**
2. **SX92202Q - The Effects of Five Different Ammonium/ Nitrate Based Fertilizers, at Two Different Nitrogen Levels, on Conifer Seedling Growth**
3. **SX92203Q - A Comparison of Various Cellulose Acetate Formulations with Peat-Vermiculite Media in Different Containers and under Different Growing Regimes**
4. **SX92204Q - A Comparison of the Effects of Overhead Irrigation and Two Subirrigation Regimes on the Development and Growth of Conifer Seedlings**

Address questions or requests for report copies to Saanich Test Nursery (604) 652-5413 or fax 652-5244

Allan McDonald
Saanich Test Nursery, Victoria

The Care of Colour Photographic Materials

Ed. note. The following is a summary of a document prepared to address concerns about the long term care and storage of slides, negatives, and photographic prints. Copies of the unexpurgated version are available from the author or the editor

1. Store photographic material in an appropriate environment.

- Store in the dark, preferably in enameled steel filing cabinets. UV and visible light fade photographic materials.
- Avoid extremes or fluctuations of temperature and relative humidity. Cold storage at about 2°C is best but below 21°C is acceptable. Ideal RH is 25% ± 5% when temperature is kept low; between 30 and 40% at room temperature. Keep Storage containers on inside walls where temperature and RH tend to be more constant than against outside walls.
- Avoid pollutants. Protect slide and photo collections from dust, ozone sources (Xerox and fax machines, laser printers, "air ecologizers"), unpainted wood, lab and paint fumes, peroxides, sulphur dioxide, nitrogen dioxide, and industrial and household cleaning supplies.
- For slide storage the Canadian Conservation Institute suggests the following three systems:
  1. bulk storage of non-enclosed slides in boxes, trays or cabinets
  2. open storage on display racks inside cabinets often fitted with a viewing light behind the pull-out racks or,
  3. archival quality plastic sleeves (see next entry) with individual enclosures for each slide, stored in binders or filing cabinets.
- Avoid Glassine, kraft, and photofinisher5 paper envelopes, most plastic storage pages, retail photo al- bums, and all other products made with PVCS. Commonly available slide and print storage pages, cover sheets in photo albums and plastic binders are usually made from PVC. Recommended plastics are polyethylene, polypropylene and polyester (tradenames Mylar and Melinex). Print File and Vue All make polyethylene storage pages.
- Paper storage materials must be acid, buffer, and alum rosin free. These materials are only available from archival suppliers.

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2. Handle and display slides and photographs with care.

- Remember the basics. Do not bend, fold, roll, staple, attach to other documents with paper clips, or leave unprotected any photographic materials. Do not leave in cars, unprotected on desks, or on light tables any longer than necessary.
- Avoid fingerprints. Handle photographic materials only after they are placed in transparent sleeves. Handle all unprotected photographic material by the edges and avoid touching the image surface or the emulsion side of slides or negatives.
- Label slides and prints carefully. For photographs: write on the back, close to the edge, in soft pencil (2B or softer), with the photograph on a hard surface. Inks can fade or bleed. For slides: use fade resistant, waterproof ink pens. For example, on plastic mounts (as well as plastic storage sleeves) use Staedtler Pancolour F permanent liner 303 (not Lumocolour), in black; on cardboard mounts try Micron Pigma 02, in black (recommendations by Betty Walsh, B.C. Archives and Record Service).
- Clean with care with a blower brush designed for negatives or lenses.
- Display photographs with care. Avoid using sticky or "magnetic" albums, or other non-archival adhesives. When projecting slides, use copies, keep projection time to a minute or less, keep the projector lamp low. When mounting photographs behind glass, use a window mat. Use acid-free, un-buffered mat board. Avoid exposure to direct sunlight. Dry-mount copy prints. Original, informational or historically significant colour pictures should not be displayed or projected.

3. Assess the collection periodically and copy or remount deteriorating slides and photos.

- Unique or important materials should be copied before quality deteriorates considerably.
- Consider copying colour photographs or slides onto durable Cibachrome prints.
- If using a commercial laboratory, specify controlled contrast and maintenance of colour accuracy.
- Replace worn slide mounts with "safe" plastic mounts (e.g., GEPE or PAKON - made of polystyrene).

4. Select high quality films and print materials.

- Colour processes in order of increasing stability are: instant colour prints, chromogenic processes (most negatives, prints, and slides), and Cibachrome prints.
- For slides: Kodak films have the best colour stability in dark storage, Fuji slides stand up better to projecting. Make originals on Kodak film and projection copies on Fuji film.
- Some good print films are: Fujicolor Super HG 200, Konica SR-G 200, Kodak Kodacolor Gold 400, Konica SR-G 400, Kodak Kodacolor Gold 1600 (see Schwalberg, Wilhelm, and Brower; Popular Photography, Vol. 97, June 1990 for more information).
- A good colour print paper is Fujicolor Super FA Type II (RA-4) or, alternatively Konica Type SR.
- Finally, always use fresh film (for both copying and originals), store it properly, use ASAP, and process immediately.

5. Consult a conservator when problems arise.

- Consult a conservator for the removal of tapes, labels, and rubber cement; flattening of rolled prints; softening of brittle prints; cleaning; or dealing with mold, separated photographic layers, or water damage. For MOF Silviculture Branch contact Betty Walsh, Conservator or Barry Byers, Chief Conservator, British Columbia Archives and Records Service, 655 Belleville Street, Victoria BC V8V IX4, (604) 387-3686, fax: 387-2072

6. Have a disaster plan for photographic materials.

- The most likely emergency events are floods, fire and earthquake. The B.C. Public Archives has a complete disaster plan for their records and can be called upon for help in the assessment phase after a disaster phase after a disaster. They will be able to advise on procedures.
- Water damage prevention strategies:
  - Locate collections away from water trouble spots.
  - Do not store collections on the floor.
  - Do not store collections in the bottom drawer of filing cabinets. Use the bottom drawer instead for storing supplies.
  - Ensure that shelves are at least 4" above the floor.
  - Shelve materials a short distance back from the edge of the shelves.
  - Don't leave collections on desks overnight.
- Earthquake precautions:
  - Stabilize shelving and filing cabinets to minimize damage.

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Summary of Recommended Materials for Slide Storage and Care

- Polyethylene storage pages such as those made by Print File or Vue All.
- File hangers made by Print File or Vue All.
- A regular office filing cabinet (enameled steel) with a letter/legal convertible hanging file drawer frame to fit inside legal drawers. Staedtler Pancolour F permanent liner 303 (not Lumocolour), in black or Micron Pigma 02, in black.
- A blower brush for keeping slides dust free.

Shamina Senaratne, SFU Coop Student
MOF Silviculture Branch, Victoria

Events

Forest Nursery Association of BC

28 September - 1 October 1992
Penticton Trade and Convention Centre

For information contact:
Marianne Boerboom, Registration Coordinator
FNABC
c/o Mountain View Forest Nursery
P.O. Box 99
Summerland, BC V0H 1Z0
(604) 494-0804

Can-West Hort Show

14-15 October 1992
Vancouver Trade and Convention Centre

For information contact:
Phil Pearsall, Show Manager
Can-West Hort Show
c/o BC Nursery Trades Association
107-14914 - 104th Ave.
Surrey, BC V3R 1M7
(604) 585-2225

Contributors to this Issue

Robb Bennett
Allan McDonald
Michelle Schmidt
Shamina Senaratne
Ministry of Forests,
Silviculture Branch
31 Bastion Square, 3rd Floor
Victoria, BC V8W 3E7
(604) 387-1191

Gwen Shrimpton
Don Summers
Dave Trotter
Ministry of Forests,
Nursery Extension Services
14275 - 96th Avenue
Surrey, BC V3V 7Z2
(604) 582-6904

John Dennis
Harry Kope
Jack Sutherland
Forestry Canada,
Pacific Forestry Centre
506 West Burnside Road
Victoria, BC V8Z 1M5
(604) 363-0600

Maarten Albricht
Ministry of Forests,
Interior Seed Orchards
3401 Reservoir Road
Vernon, BC V1B 2C7
(604) 549-5577

Clare Kooistra
Shon Ostafew
Ministry of Forests
Forest Extension and
Nursery Administration Centre
3201 - 30th Street
Vernon, BC V1T 9G3
(604) 549-5591

Kas Dumroese
Forest Research Nursery
University of Idaho
Moscow, ID
USA 83843
(208) 885-7017